Workforce Competency Dictionary

NASA Competency Management System (CMS)

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Workforce Competency Dictionary

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PREFACE

PURPOSE

The NASA Competency Management System (CMS) is a collection of business processes and tools that are used to measure and monitor the Agency's corporate knowledge base. A competency is a conceptual representation of a body of knowledge. The competencies are used to categorize the capabilities of an employee, identify the knowledge requirements of a job position, forecast the workforce requirements for a project, and stimulate the interaction and sharing of knowledge across the Agency.

CMS USAGE POLICY

Intended Use

Strategic Human Capital Management: The Competency Management System is primarily a workforce-planning tool that will help the Agency ensure it has the competencies needed for the future workforce. It identifies competencies for employees, job positions, and program/projects. By combining this data with other related information (such as project schedules, mission priorities, allocated resources, etc.), it provides insight into the Agency's workforce capabilities, which enables appropriate decision makers to set guidelines for human capital programs (such as staffing, training, etc.). The program managers can use the competency information to augment other workforce information to align the workforce to the Agency's mission.

Integration of Business Processes: The Competency Management System provides a frame of reference. This allows business processes that are related, to map their objectives and data to competencies. This allows the exchange and integration of information between the processes utilizing a common language.

Employee Development: The Competency Management System provides employees and supervisors an additional avenue to help determine the knowledge areas. This sets the focus for defining the appropriate developmental activities that would further enhance the employee's capabilities.

Expertise Locator: The Competency Management System provides employees, supervisors, project managers, functional offices, enterprise management, and senior leadership the capability to locate expertise within the Agency's Workforce. It provides insight the Agency's Corporate Knowledge Base

Knowledge Management: The Competency Management System can help connect employees with the same or similar competencies into communities of practice. This allows other systems and tools, such as portals, to more easily connect the community with other knowledge management tools (such as Lessons Learned, Technical Documents, etc.) that are similar or related to the competency.

Communication Tool: The Competency Management System provides a mechanism to understand the Agency's Corporate Knowledge Base that enables improved communication across project, functional, and organizational boundaries in an effort to realize and apply the full capability of the workforce to accomplish NASA's mission by providing a consistent language and framework.

Restrictions and Limitations

Job Selection: The Competency Management System is not designed or used as an Agency employment and selection system. It does not meet, nor is required to meet, the Uniform Guidelines on Employee Selection Procedures (29 CFR 1607). When defining a job, competencies relate to, and can help define, the knowledge requirements for the position.

However, there are other qualification factors defined in terms of abilities and skills that are used during the competitive process. [For detailed information about the job selection process, see the NASA HR Desk Procedure on "The NASA Competitive Placement Plan for Positions GS-15 and Below (Including Trades and Labor Positions)"]

Pay Setting: Most employees are in pay systems that are position-based. This means that basic pay is determined by the classification of the duties and responsibilities of the position to a particular grade or pay level. . The intent of the federal pay system is to ensure that there will be equal pay for equal work. Competencies help to define the Knowledge part of the position requirements. Some competencies are required for a position and help to determine grade and pay. However, these competencies are defined and delineated via the job analysis and classification process, NOT through CMS. Other competencies an employee may possess that are not related to his/her position do not impact the classification of the position. [For detailed information about pay setting, see the NASA Desk Guide on "Pay Setting")

Employee Performance Evaluation: An employee`s performance plan will be based on an employee`s work assignments and responsibilities and must contain at least one element that addresses the individual's performance and its relationship to NASA`s Strategic Plan. Competencies are a body of knowledge and therefore cannot be used to plan or evaluate employee performance. [For detailed information about employee performance, see the NASA Policy Guide 3430.1A "NASA Employee Performance Communication System (EPCS)"]

Task/Work Assignments: Competency information can provide supervisors with limited information about what an employee may know. It does not capture or communicate the other items that a supervisor would need in order to assign an employee to a particular task or job, such as how the employee applied their knowledge (which projects, products, tasks) how the employee performs, other special skills or capabilities that an employee may posses, availability of the employee, among others. The Competency Management System is not intended to replace supervisor judgment or direct communication with employees. [For detailed information about work assignments, contact your supervisor]

Other: Any application, or use of the competency data must comply with all related NASA HR Policies and Guidelines.

Privacy Act Notice:
Records that relate to employees contained in the Competency Management System (CMS) are subject to the Privacy Act and must be safeguarded against unauthorized disclosure in accordance with 14 C.F.R. 1212.605. Unauthorized disclosure of Privacy Act records may result in criminal penalties under 5 U.S.C. 552a(i)(1) and (2).

Disclaimer

The content in this section on the CMS Usage Policy is provided to the reader as a synopsis of how the competency information and implementation relates to selected NASA Human Resource Policies and Procedures, which are governed by extensive Federal Laws, Regulations, and Guidelines. This information does not supplement or supercede any NASA Agency, or Center, HR Policy or desk procedure. For any questions about competency information as it relates to personnel actions please contact the Human Resource Office at your Center.

BUSINESS RULES & GUIDELINES

(1) Guidelines for the number of competencies per position: The intent of the process is to identify competencies that are required for a job position AND that would be utilized most of the time, or are critical knowledge areas for the position. It is not the intent of the system to capture every possible competency that could be used. Every position should have at least one competency identified, and for most positions it is expected there will be anywhere between 2 and 10 competencies assigned. The CMS system has enough fields to accommodate up to 20 competencies for any position, however, it is expected that there will be few positions that will need to be assigned more than 10 competencies.

(2) Guidelines for the number of competencies per employee: Individuals are to identify the areas of knowledge that they have acquired through past education or work experience. However, it is not feasible, nor the intent of this

system, to capture everything a person may know. Therefore, the employee should limit and select the competencies that best describe the knowledge areas that they have utilize most often in the present, or in the past. At a minimum, these should include the competencies that they are using in their current job position. Additional competencies should reflect only those bodies of knowledge that employees feel are current enough to be usable, with or without some refresher development, to a maximum of 20 competencies per person.

(3) Rules for Primary Competency: For every job position, one of the required competencies should be designated as a "primary" competency. It should be the one that best describes, or represents, the knowledge that is utilized the most over a given fiscal year. All competencies identified for a job position are considered of equal value. The primary competency is used during the workforce planning process to help simplify forecasting and the data analysis.

(4) Rules for identifying required competencies for specific position types:

- Senior Executive Service (SES) positions should have Leadership (140) as a primary competency, with secondary competencies to include Business Management (113) and technical workforce competencies as appropriate
- Middle Management positions should have either Business Management (113) or a technical workforce competency as a primary competency, depending upon the nature of the position. If Business Management is chosen as a primary competency, appropriate technical competencies should be included as secondary competencies; conversely, if a technical competency is chosen as primary, Business Management should be included as a secondary competency
- 1st Line Supervisors should have a technical workforce competency as their primary competency and Business Management (113) as a secondary competency
- Technicians should have Engineering and Science Support (11) as the primary competency with other technical competencies as secondary
- Administrative Officers should have Business Management (113) as the primary competency and other competencies as secondary. (*Example: Financial Management, Budgeting Management, etc.*)
- Secretary positions should have Administrative Support (115) as the primary competency.
- student trainees/co-ops competencies are not required

Any exceptions to these business rules should be reviewed with Center CMS representatives.

(5) Guidelines for Levels of Proficiency: Proficiency is a measurement of an employee's demonstrated level of capability utilizing the associated body of knowledge. It categorizes the depth of knowledge within any single competency or subcompetency. Reference the "Proficiency Guideline Table" in Appendix B.

REVISION HISTORY

REVISION	DATE	COMP ID	CHANGE
4b	2/3/2004		NO CHANGES WERE MADE TO COMPETENCIES Preface was added. Index was added Cross Reference Table was added.
4a	1/21/2004		NO CHANGES WERE MADE TO COMPETENCIES New Competency Groupings replaced the previous hierarchy.
4	7/21/2003	64	Analytical and Computational Structural Methods has been clarified as a research competency and is applicable to structures discipline

REVISION	DATE	COMP ID	CHANGE
		122	Program/Project Management was modified to separate out knowledge associated with program/project analysis (147).
		126	Physical Security was modified to separate out knowledge associated with export control (144).
		130	Occupational and Environmental Health & Safety was expanded.
		132	Facilities Planning and Operations has been renamed and subdivided into 4 new competencies: ▪ Institutional Facilities Planning (145) ▪ Institutional Facilities Operations (146) ▪ Research Facilities Planning (132) ▪ Research Facilities Operations (148)
		138	(new) Nuclear Engineering has been added.
		139	(new) Software Assurance Engineering has been added.
		140	(new) Leadership has been added.
		141	(new) Personal Communication has been added.
		142	(new) Relationship Management has been added.
		143	(new) Fire Protection Engineering has been added.
		144	(new) Export Control has been added.
		145	(new) Institutional Facilities Planning has been added.
		146	(new) Institutional Facilities Operations has been added.
		147	(new) Program/Project Analysis has been added.
		148	(new) Research Facilities Operations has been added.
3			BASELINE – First dictionary approved by the Competency Management System Agency Implementation Team
2			WORKING DRAFT
1	12/12/2002		INITIAL DRAFT

1. Business Competencies

1.1. Business Operations

1.1.1. Administrative Support (ADMSUP) [115]

Knowledge, capabilities and practices associated with administrative and clerical support to a manager and/or organization to facilitate the mission, goals and customer satisfaction. Use knowledge of administrative techniques, tools policies and/or procedures to provide enabling functions such as timekeeping, scheduling, office communications, document generation, and tracking and follow up systems. Integrate knowledge of specialized processes, resources, terminology, with administrative skills to improve efficiency of business operations.

1.1.2. Partnership & Business Development (BUSDEV) [116]

Knowledge, capabilities and practices associated with the effective targeting and acquisition of external partnerships and business opportunities, including funding opportunities for projects and programs Includes an understanding of the Agency's strategic plan, the ability to identify, assess and forecast new business opportunities such as technology transfer, and develop and use appropriate marketing strategies. Requires knowledge of relevant markets, customer needs in those markets, and an ability to recognize and analyze market trends. Involves development of proposals to win business, and management of existing agreements with external entities such as industry, government, university, and international partnerships. Also includes knowledge of Space Act Agreements, and an ability to facilitate and manage partnerships that support Agency strategies, partner requirements and Space Act provisions. Ability to integrate and work with the appropriate elements of the agency's technical and support communities.

1.1.3. Business IT Systems (BUSITSYS) [131]

Knowledge, capabilities and practices associated with computer architectures and computer-based information systems related to business operations and mission support. This competency is based on knowledge comprised from one or more of the following interrelated technologies: computer and other hardware, programming languages, commercial operating systems, web or database systems, network hardware and software, IT security and other technologies that pertain to the acquisition, computation, storage, distribution, reporting, and management of information.

1.1.4. Business Management (BUSMMT) [113]

Knowledge of principles and practices related to managing the internal and external operations of a business unit such as a Center to effectively accomplish mission objectives and goals, achieve customer satisfaction, develop strong relationships with other NASA and external entities, and adhere to agencywide programs, policies, and procedures. Understanding of internal operations and processes, and how to support or modify processes in order to optimize efficiency and information for decision making.

1.1.5. Commercial Technology (COMTEC) [117]

Knowledge and abilities associated with transferring current and future Agency technology to external entities in order to meet broad Agency vision and missions, and extend the lifecycle and broaden the usefulness of Agency technologies. Involves expertise in business practices pertaining to intellectual property, patents, licenses and partnerships as well as general business knowledge for assessing potential partners. Includes broad understanding of Agency technologies and programs, as well as familiarity with external entities and markets.

1.1.6. Education Programs and Technologies (EDTECH) [137]

Knowledge, capabilities and practices associated with the research and application of education programs, standards, requirements, activities and services relevant to the fields and disciplines of science, technology, engineering, and mathematics (STEM) within the contexts of pre-college, higher education, and non-traditional learning. Includes knowledge of education concepts and principles, curriculum development, infrastructure, audiences, instructional technologies and distance learning tools, and trends in order for NASA to appropriately influence and contribute to national and state education initiatives and requirements through the use of NASA's unique assets. Includes knowledge of NASA Enterprise and Center-based research and technology needs, and ability to align education activities and programs with these needs. Includes knowledge of demographic and geographic dynamics that influence the educational effectiveness and success within the various student and educator communities.

1.1.7. EEO (EEO) [129]

Knowledge, capabilities and practices associated with the application of EEO initiatives and programs. This includes the formulation, delivery and management of EEO systems applied to meet NASA EEO goals and objectives, as well as the knowledge of related public law, NASA directives and policies.

1.1.8. Export Control (EXPORT) [144]

Knowledge, capabilities, and practices associated with complying with federal laws controlling the export of items and technical data. This includes the formulation and implementation of export control policy, plans, and procedures that ensure compliance with federal law. The primary focus of export control it to ensure compliance through programs, education of the workforce, and addressing unique situations in the aerospace environment.

1.1.9. Governmental Affairs (GOVAF) [136]

Knowledge of NASA-related legislation, the legislative process and public affairs as it pertains to NASA. Includes the ability to monitor legislation that is of interest to NASA, monitor NASA-related hearings and markups scheduled before the House and Senate committees and subcommittees that have oversight over NASA, to especially include Authorization and Appropriations subcommittees. Ability to help manage NASA press releases of Congressional interest and identify key members and issues of importance to them. Broad knowledge of NASA programs and specific knowledge of local center programs.

1.1.10. Human Resources (HUMRES) [128]

Apply knowledge and practices of the full range of personnel/human resource functions, such as classification, workforce planning & analysis, employee and labor relations, retirement, benefits, disciplinary actions, recruitment, selection, training, employee development, promotion regulations and procedures, compensation, and personnel information systems. Provide guidance and leadership in the motivation, performance measurement and overall management of the workforce including the design, delivery, implementation and evaluation of programs and processes. Includes understanding of organizational mission, strategy and business objectives as well as various rules, regulations and culture on people and their work.

1.1.11. Inspection, Investigation and Compliance (INSCOMP) [127]

Knowledge of how to provide objective evaluation of Agency standards and operation through use of inspection and investigation techniques and compliance audits. Understanding of how to assess risk, evaluate evidence, design and conduct inquiries such as inspections and investigations, and make recommendations to prevent, detect or solve crime, fraud, waste and abuse and ensure efficient Agency operations. Involves understanding of how to communicate information to constituents, including Agency leadership and management, employees, and Congress.

1.1.12. Legal (LEGAL) [125]

Knowledge, capabilities and practices associated with representation, counseling, advising, researching, performing, and / or supervising professional legal work in the administration of applicable statutes, regulations, Executive Orders, rules, and case law. This includes knowledge of topics such as procurement, claims, agreements, fiscal matters, personnel matters, environmental matters, FOIA, Congressionals, ethics, patents, intellectual property, appeals, and litigation.

1.1.13. Occupational and Environmental Health & Safety (OCCENV) [130]

Knowledge, capabilities, and practice associated with NASA, Federal, and State OSHA health and safety regulations, policies and procedures used to develop and implement mishap and environmental health prevention practices and measures in all NASA work places. These knowledge areas include safety of personnel and equipment during launch vehicle processing, normal and industrial and laboratory operations, special high hazard tests and operations, aviation and space operations, use and handling of materials and chemicals, and design, construction, and use of facilities. Capabilities include ability to develop and analyze policy, manage, and assess the effectiveness of health and safety programs and practices, which are designed to prevent injury to personnel and loss of NASA property in the industrial work environment, and promote the health and well being of employees.

1.1.14. Public Communications & Outreach (PUBLICOMM) [135]

Knowledge, capabilities and practices associated with the assessment, development and execution of public communication and outreach efforts. Knowledge of effective public relations and presentation techniques for representing and expressing the views, work operations and policies of NASA including liaising with and presenting information to a variety of external audiences. Effectively advocates for the Agency through communication of the organization's expertise and contributions, and assessing the effectiveness of past or ongoing efforts. Apply principles and practices of domestic and international customs, regulations and details to ceremonies or other interaction with distinguished visitors or in public forums. Manage Agency knowledge so it can be accessed where and when needed for communication purposes inside and outside the Agency. This includes public writing and speaking, information collection and dissemination, news broadcasting and writing, media relations, exhibit design, story development, visitor and guest programs, protocols, and concessionaire management.

1.2. Financial Operations

1.2.1. Budgeting Management (BUDGETMMT) [119]

Knowledge of how to apply management knowledge, principles and practices to obtain, utilize, manage financial resources in the workplace to meet program, project or business requirements. Involves maintaining available resources, making resource decisions based on need and availability, and developing and implementing strategies to make rational and well thought-out decisions related to organizational resources. Includes the ability to provide guidance, formulate a budget plan, defend a budget plan, assess budget performance, advocate budget and alternative scenarios and execute a budget plan. Requires knowledge of policies and practices related to Federal, Agency and Installation accounting, and internal business information systems.

1.2.2. Acquisition and Contract Management (CONMMT) [124]

Apply knowledge and practices associated with solicitation, negotiation, development, selection and administration of contracts/services, in compliance with public law, executive orders, Federal regulations and Agency requirements, policies and initiatives. Use knowledge of contracts to review products and services to determine if they are in compliance with contract terms and conditions. Includes ability to assess technical requirements needed to support program and project implementation, and provide technical guidance and direction to contractors to ensure delivery and quality of services and products. Use contract or acquisition instruments and surveillance systems as necessary to ensure contract or acquisition requirements are being met through the life of the contract.

1.2.3. Cost Estimation Analysis (COSTEST) [121]

Knowledge and practices associated with the determination, estimation, and analysis of costs associated with business functions, programs/projects, processes and/or tasks. Includes preparing, justifying and/or managing costs associated with initiatives to set priorities and track expenses in support of organizational objectives. Involves skill with developing and using estimation algorithms that draw on large volumes of technical historical data.

1.2.4. Financial Management (FINMMT) [118]

Understanding of how to apply management knowledge, principles and practices, generally accepted accounting principles (GAAP), and the standards, policies and practices related to Federal, Agency and Installation accounting and financial management to obtain, utilize, and manage resources in the workplace. Ability to develop and implement strategies to maintain and allocate organizational resources rationally and effectively.

1.2.5. Internal Control / Audit (INTAUD) [120]

Knowledge of how to evaluate control systems for financial, administrative, program, and operational activities to provide reasonable assurances that obligations and costs comply with applicable law, that property is funded, and assets are safeguarded; and that revenues and expenditures applicable to operations are properly recorded and accounted for. Involves ability to conduct surveys, studies and other investigations in management operations to assess adequacy of present systems and make recommendations based on analysis.

1.3. Institutional Support

1.3.1. Institutional Environmental Engineering & Management (ENVENGMMT) [133]

Uses knowledge of environmental engineering, chemistry, biology, geology and hydrogeology to maintain a proactive stance regarding environmental stewardship, including protection and restoration of environmental resources such as ground water, surface water, soils, sediments and air. Assesses compliance to environmental standards, regulations, Executive Orders, and directives. Implements proactive programs such as recycling, pollution prevention, affirmative procurement and energy management.

1.3.2. Fire Protection Engineering (FIREPROT) [143]

Knowledge, capabilities and practices associated fire prevention-related tools and their application to systems for minimizing the occurrence or effects of fire. Maintains comprehensive knowledge of applicable NFPA, OSHA, NASA, aerospace and/or prevention industry trends, standards and policies for fire prevention. Demonstrate a comprehensive knowledge of and contributes to resources available in the fire prevention community including NASA, DOD, academia, and industry. Capability to review and assess complex technical documents for their impact on fire prevention work. Maintain a comprehensive knowledge of Life Safety Systems. Capability to provide mitigation strategies for fire protection when requirements cannot be met.

1.3.3. Institutional Facilities Operations (INSFACOPS) [146]

Knowledge of operations and maintenance principals and techniques for real property, technologically complex facilities, and associated systems and equipment. Ability to develop and manage a comprehensive program of facilities management services to sustain and optimize institutional and research and development (R&D) facilities and equipment consistent with codes and regulations, including schedules, tool/equipment operations & maintenance, safety procedures, and reporting/record keeping for key facilities such as wind tunnels and scientific laboratories. Effectively integrate these services to be consistent with the broader objectives, strategies, and program goals of the organization.

1.3.4. Institutional Facilities Planning (INSFACPLAN) [145]

Knowledge of strategic and long-term master planning for institutional and research and development facilities and equipment required to support business operations and current and future program needs. Ability to plan technologically complex sustainable facilities that provide a suitable environment, including logistics, workspace planning, communication infrastructure, and public space. Knowledge of how to develop functional and facility requirements and the associated costs and scheduling, and coordinates necessary facility engineering to satisfy all functional and regulatory requirements. Devise and implement policies and procedures regaring safety and fire prevention, emergency prepared ness, property parking and records space planning.

1.3.5. Institutional Logistics, Supply and Transportation (LOGSUPTRAN) [134]

Knowledge of principles, practices, equipment and tools in the areas of Logistics, Supply and Transportation. Understanding of how to manage and optimize equipment, supplies and transportation systems to provide an infrastructure that enables the agency to operate effectively. Includes management of specifications, acquisition, certification, storage, delivery, lifecycle support, distribution, and disposal of supplies, hardware, materials, equipment, and property (except real estate) and the operation and maintenance of transportation and other equipment used to move materials or passengers. Also includes management of inventories, including government property, equipment and materials provided to employees and contractors, so that the property is accurately accounted for, reported against and disposed of at the end of its useful life. Requires understanding of government regulations regarding property management and disposal, and related contracting terminology and requirements.

1.3.6. Physical Security (PSEC) [126]

Knowledge and practices associated with facilities, personnel and operational security. Ability to develop, implement, and manage processes and programs involving law enforcement, emergency preparedness and fire prevention measures to ensure the security of the facilities and employees. This competency includes the commitment to protect lives, property and operations.

1.4. Professional Development

1.4.1. Leadership (LEADERSHIP) [140]

Use expertise and persuasiveness to influence others to follow a particular path and/or perform to their highest capabilities. Create and communicate a shared-vision by making effective decisions, supporting and developing peers and coworkers, fostering collaboration and fair work conditions, motivating others, and advocating and leading positive organizational change. Excel in personal effectiveness, working with others, communication & advocacy, and management of resources.

1.4.2. Personal Communication (PERSCOMM) [141]

Knowledge, capabilities and practices associated with effective interpersonal and group communication, communication mechanisms such as facilitations, meetings and tools, as well as the general environment for communication. It includes gathering, comprehending and expressing thoughts and ideas in an effective and appropriate manner using the appropriate verbal, non-verbal, listening, writing, reading, facilitation and presentation skills.

1.4.3. Relationship Management (RELATIONSHIP) [142]

Knowledge, capabilities and practices associated with the assessment, development and maintenance of the Center's various stakeholder relationships. This includes building and maintaining alliances (from internal collaboration to external partnerships) as well as ensuring a strong customer-orientation and/or partnership practices in interactions involving internal and external stakeholders, including members of industry, government, internationals, and academia. The primary objective is to employ these capabilities to monitor and help ensure (directly and indirectly) the highest levels of effectiveness and satisfaction possible.

2. Engineering & Technology Competencies

2.1. Systems Engineering

2.1.1. Design and Development Engineering (DESDEV) [8]

Knowledge, capabilities and practices associated with all aspects of the technical design and development process including the development of flight hardware, payloads, technology projects fabrication processes and techniques, concurrent engineering, production assessment, and process verification as applied to aerospace vehicles and systems used in atmospheric and space environments. Includes ability to create models and prototypes, particularly in a laboratory setting, based on research oriented plans and schematics and capability to design the system for safe and reliable development, integration and manufacturability.

2.1.2. Engineering and Science Support (ENGSCISUP) [11]

Knowledge, capabilities and practices associated with supporting engineering and science functions. This support includes laboratory, modeling, manufacturing and analytical activities. Focus is on the abilities of an individual to visualize, plan and execute limited instructions from engineering, in the form of drawings/schematics, written or verbal direction, in order to produce a model, prototype or finished product. The technician's application of tools and apparatus, both physical and analytical, are a key element of this competency.

2.1.3. Integration Engineering (INTEGENG) [9]

Knowledge and capability to integrate all elements into a functioning system or subsystem such as complex flight to flight and flight to ground and facilities systems. Includes knowledge and capabilities required for safe and reliable integration of different elements of a system, schedules, configurations and resources as well as the development of launch, mission, manifest, contigency and long-range plans and responses to externally-driven requirements.

2.1.4. Manufacturing Engineering (MANUFACT) [24]

Knowledge, capabilities and practices to perform concurrent engineering and producibility. Includes knowledge and ability to review design documentation, determine resource requirements for manufacturing activities, research and develop manufacturing processes, plan and manage hardware fabrication and assembly, develop and maintain manufacturing project schedules, and resolve manufacturing related problems.

2.1.5. Mission Analysis and Planning (MAP) [1]

Knowledge and ability to analyze requirements of current and near-term missions. Manage integration of technical elements such as vehicle design, flight trajectories, and operational and ground-based infrastructure requirements in order to meet mission and programmatic objectives.

2.1.6. Process Engineering (PROCENG) [114]

Knowledge, capabilities and practices associated with the development and implementation of safe, efficient, and effective processes to achieve performance excellence in Center operations, development, and enabling functions. This includes the identification, development, mapping, modeling, measuring, and analysis of processes that enable work activities, including their suppliers, inputs, outputs, customers, outcomes, and related decisions. Areas of specialization include queuing theory, function analysis, task analysis, human factors, stochastic methods, advanced statistical analysis methods, optimization algorithms, process simulation modeling (discrete and/or continuous), linear programming, and scheduling and capacity analysis systems.

2.1.7. Systems Engineering (SYSENG) [7]

Knowledge, capabilities and practices associated with defining, developing, integrating and verifying an end-to-end new or existing system, with the objective of optimizing performance, safety and mission objectives. Includes knowledge required for safe and reliable system development/integration. Ability to perform feasibility assessments, provide functional analyses; develop and manage system performance and interface requirements to ensure the resulting system meets all technical objectives; perform systems analysis and trade studies, and oversee systems integration and verification. Includes knowledge of system engineering tools and procedures such as configuration management and integrated schematics for defining interconnection of system parts, documenting and managing system configurations and identifying all required interfaces, and mass properties for determining weight distributions. Assumes a breath of knowledge of many specialty areas, and a conceptual understanding of how the pieces fit together.

2.1.8. Test Engineering (TESTENG) [10]

Knowledge of physics, engineering and manufacturing to test systems or subsystems under development for their functioning, efficacy and conformance to design requirements, or to test prototypes for feasibility. May involve ability to plan, conduct, and evaluate developmental, qualification, and acceptance testing in accordance with NASA, Military or Commercial Specifications of air, space and ground systems, components, piece parts, as well as integrated systems. Includes knowledge of environmental test techniques used to simulate loading conditions such as launch, reentry, orbit, and landing, including vibration, shock, acoustics, contamination, acceleration, electromagnetics, radiation, pressure, thermal, chemical, microgravity and solar vacuum, aerodynamics and temperature and humidity. Includes knowledge required for safe and reliable system development/integration.

2.2. Systems Analysis & Mission Planning

2.2.1. Advanced Mission Analysis (ADVMIS) [89]

Knowledge, capabilities, and practices associated with the conception, development, and planning of advanced missions and systems synthesizing science, commercial, military and exploration requirements and considering feasibility, performance, cost, reliability/safety and environmental effects. Also includes understanding of architecture analysis methods and optimization.

2.2.2. Aerospace Systems Concept Development & Technology Assessment (ASCDTA) [90]

Knowledge, capabilities and practices associated with the development of aerospace vehicle and spacecraft concepts from a systems perspective to satisfy prescribed mission architectures and identify enabling technologies for performance, cost and safety. Knowledge of conceptual design, sizing & synthesis of aerospace vehicles or spacecraft. Knowledge of elicitation from subject matter experts of the potential technology improvements from R&D projects in all the relevant aerospace disciplines.

2.2.3. Mission Flight Design (FLTDSG) [2]

Knowledge and ability to conduct computational analysis of air and space vehicle flight design for mission requirements, including sequencing, trajectory optimization, orbital mechanics, flight mechanics and celestial mechanics. Use flight design modeling and simulation tools that determine optimum trajectory solutions for the appropriate mission and vehicle constraints. Includes in-depth analysis of air borne and ground-based trajectory predictions, automated trajectory planning and modeling and trajectory negotiation and data exchange as well as optimization tools which take into account environmental and design constraints. Involves analysis of flight dispersion variables once trajectories are established.

2.3. Aeronautics

2.3.1. Acoustics (ACOUSTICS) [103]

Knowledge, capabilities, and practices related to interior and exterior noise reduction and acoustic design for advanced aerospace systems, subsystems, and components to meet environmental requirements. Includes knowledge and application of experimental and computational aero and structural acoustics. Inherent in this competency is the capability to determine the influence of acoustic environment on ground observers and vehicle passengers alike, as well as to develop an understanding of its impact on vehicle structural responses, including sonic fatigue. Includes ability to conceive, plan, and implement appropriate experimental and flight test programs that are designed to understand and predict the acoustic environment and to validate advanced active and passive noise control concepts.

2.3.2. Aerodynamics (AERODYN) [101]

Knowledge, capabilities and practices associated with fluid mechanics and flow physics modeling and their application to aerodynamic design for aerospace vehicles and components, such as transport and military aircraft, space transportation and launch vehicles, and propulsion systems and their integration with vehicles. Ability to plan, conduct, interpret and correlate results of experimental investigations and computational fluid dynamics (CFD) analyses to predict aerodynamic performance.

2.3.3. Aeroelasticity (AEROELA) [100]

Research knowledge, capabilities, and practices for investigating aeroelastic phenomena and complex steady and unsteady aerodynamic flow phenomena especially in the transonic speed range, for investigating, developing, and demonstrating novel concepts that prevent aeroelastic instabilities, alleviate adverse aeroelastic responses, reduce loads and vibrations, and exploit the aeroelastic characteristics of aerospace vehicles, for developing analytical methods that predict the aeroelastic and aeroservoelastic responses of aerospace vehicles, and for conducting unsteady aerodynamic, aeroelastic, and aeroservoelastic wind-tunnel tests.

2.3.4. Aerothermodynamics (AEROTHM) [102]

Knowledge, capabilities, and practices related to aero/aerothermodynamic design for aerospace vehicles and components under various flight conditions including liftoff, ascent, stage separation and reentry. Ability to plan, conduct and interpret results of experimental investigations and analytical/computational fluid dynamics to derive aerothermal environments. Inherent within this competency is also the ability to determine the effects of propulsion system plumes on the vehicle/components performance and environment. Knowledge of high temperature gas physics including molecular and atomic internal energy structure, rate processes, and radiative emission characteristics.

2.3.5. Applied Aerodynamics (APPLAERO) [99]

Knowledge of the aerodynamics of flight vehicles focused on improving aerodynamic performance and stability and control of current and future aircraft. Includes knowledge of areas such as analytical and CFD prediction methods, wind tunnel and flight testing techniques, unsteady and high angle of attach flow phenomena, internal flows, propulsion airframe integration, rotary wing aerodynamics, cavity flows, etc. Aerodynamics phenomena are studied over a broad range of Mach numbers, Reynolds numbers, and flight conditions. Assumes a broad understanding of aerodynamics and engineering disciplines.

2.3.6. Air Traffic Systems (ATS) [108]

Knowledge of Air Traffic Management elements, and their properties and interactions, such as air space and range systems, air traffic regulations, aircraft characteristics, airport structures and systems, and geographic and topographical patterns. Apply knowledge of these elements to the development of new systems and tools to improve the efficiency, effectiveness and capacity of the air traffic system, using advanced distributed modeling techniques to research and test concepts and prototypes.

2.3.7. Flight Dynamics (FLTDYN) [98]

Knowledge, capabilities, and practices associated with research and technology in analytical, computational, and experimental methods to characterize the flight dynamics behaviors of aerospace vehicles.

2.3.8. Simulation/Flight Research Systems (SIMFLTSYS) [110]

Knowledge capabilities and practices used to provide and integrate appropriate real-time hardware/software systems in support of piloted simulators and research aircraft that enable experiments in Flight Dynamics, Guidance/Navigation/Control, Crew Systems and Aviation Operations, Reliable Digital Systems and Electromagnetics.

2.4. Facilities

2.4.1. Architectural Engineering (ARCHENG) [112]

Knowledge of architectural design, architectural/facility evaluation, cost, schedules and formulation of performance requirements and alternative analysis/scenarios for key facilities such as wind tunnels and scientific laboratories.

2.4.2. Research Facilities Operations (RESFACOPS) [148]

Knowledge of operation and maintenance of research facilities, and associated systems and equipment. Includes but is not limited to: knowledge required to develop and manage a comprehensive program of research facilities management services, such as test planning and development, devlopment of operational plans and procedures, data acquisition and analysis, test scheduling, resource planning, development of research facility capability enhancements, reliability centered maintenance, energy conservation, system health monitoring, minor facility modification and repair, etc., to operate, sustain and optimize research facilities and equipment. Includes the ability to effectively integrate these services to be consistent with the strategies and program goals of the organization.

2.4.3. Research Facilities Planning (RESFACPLAN) [132]

Knowledge of strategic and long-term planning for research and development (R&D) facilities and equipment required to support research facility operations for current and future program needs. Knowledge required to develop functional and facility requirements and the associated costs and scheduling. Includes knowledge required to coordinate and incorporate the necessary facility engineering to satisfy all functional, institutional and regulatory requirements. Specialized knowledge of high energy/ high risk systems including but not limited to: high temperature systems, high pressure systems, cryogenic systems, exotic gases, control systems, data acquisition systems, energy transfer systems, laboratory workspace planning, communication infrastructure. Includes abilities to devise and implement policies and procedures regarding risk/hazard mitigation and safety assurance.

2.5. Human and Biological

2.5.1. Bioengineering (BIOENG) [58]

Application of technologies to living systems including such areas as biomechanics, imaging, biomedical transducers, biofluids and sensors.

2.5.2. Biomedical Engineering (BIOMEDENG) [35]

Knowledge of engineering, design, development, analysis and test of biomedical systems such as equipment and tools for maintaining crew psychological and physical health for long-duration missions in space. Involves knowledge of broad array of engineering disciplines, and biomedical research, human factors and space medicine findings and practices. Includes knowledge of operational impacts and sustaining engineering on the systems.

2.5.3. Biomimetics (BIOMET) [59]

Knowledge and capability to research and further study natural processes which have potential to be deciphered, mimicked and adopted in technology applications based on biological systems such as environmental heat sensors, retinal or iris scans or face recognition technology. Also includes capabilities in the area of neural electric machine control.

2.5.4. Crew Systems and Aviation Operations (CSAOPS) [97]

Knowledge, capabilities, and practices associated with research and technology in analytical and experimental methods for pilot/automation integration, crew station design, and aerospace vehicle operations concepts.

2.5.5. Extravehicular Activity Systems (EAS) [38]

Knowledge of engineering, design, development, analysis and test of EVA systems. Requires knowledge and skills regarding the unique environment and constraints in sending a crewmember into space outside of a vehicle, and expertise in designing and developing spacesuits, tools, mechanisms, and operations that support such an activity. Includes knowledge of operational impacts and sustaining engineering on the system.

2.5.6. Environmental Control and Life Support Systems (ECLSS) [37]

Knowledge, capabilities and practices associated with environmental control and/or life support systems used to protect life in dangerous or insupportive environments for flight or ground operations, including related instrumentation, controls, data acquisition, pneumatics and mechanisms. May include knowledge and capabilities needed for development of advanced and/or regenerative life support, such as how to apply plant physiology and pathology, microbial ecology, molecular biology, biological engineering, chemistry, chemical engineering and landscape ecology to development of advanced, regenerative life support such as air and water recycling, solid waste resource recovery, food sources and thermal environmental control.

2.5.7. Habitability and Environmental Factors (ENVFACT) [39]

Knowledge of practices associated with research of and applying research to the habitability of spacecraft and space-based environments and the environmental effects on humans and other organisms with specific emphasis on barophysiology, microbiology and toxicology and radiation. Knowledge of physical and chemical sciences, including heat and mass transfer, acoustics, radiation, thermodynamics, fluid mechanics, and chemical, biological, metabolic and human factors processes. Ability to integrate and apply this understanding to develop systems and technology to enable humans to live and work safely and effectively in space.

2.5.8. Fundamental Human Factors Research (FUNHUM) [40]

Knowledge of human engineering research methods (e.g. literature search, experiment, operational analysis, observation, survey, protection of research subjects) and activities (e.g., experimental design, planning data collection, data analysis, statistics, and documentation. Knowledge of the effects of environmental, individual, cognitive and organizational factors on the behavior and performance of humans, as well as the associated underlying physiological, psychological and social/organizational drivers that influence human behavior. Includes knowledge of a variety of psychophysical areas such as, but not limited to, biomechanics, perception, cognition, sensory-motor control, communication, decision-making, and teamwork and human-automation interaction. Ability to apply theories, experimentation, analysis and modeling to increase fundamental knowledge about human cognition and performance. Ability to develop human factors principles and guidelines which could be used toward designing technology for human performance in complex aerospace operational environments to reduce errors and increase productivity.

2.5.9. Human Factors Engineering (HUMFAC) [41]

Knowledge and capabilities to apply human factors engineering principles, standards, design guides, regulations, and advisory material to the .design, test, evaluation, operation, and maintenance of systems and processes. Knowledge of the physical and psychological processes, capabilities, skill levels, and limitations of humans, such as the science and practical application of experimental psychology, cognitive psychology, human reliability, anthropometrics, biomechanics, and psychophysiology. Knowledge of hardware and software human-interface design principles, modalities (e.g. physical, visual, auditory, verbal), methods (e.g. field studies, analysis, modeling, prototyping, laboratory experiments, simulations, mockups, database reviews) and tools. The ability to define and analyze human engineering requirements, formulate human performance criteria, develop guidelines, develop system concepts, designs, and prototypes; evaluate human-centered technologies, and develop training curricula for application to processes and systems.

2.6. Chemical

2.6.1. Chemistry/ Chemical Engineering (CHEMENG) [25]

Knowledge, capabilities and practices associated with Chemistry and Chemical Engineering as applied to aerospace systems for ground and flight application, particularly for use in sensors, material sciences, propulsion, environmental, ecological, biological or laboratory processes. This includes an understanding of organic, inorganic, analytical and physical chemistry and their application to a wide variety of research, development, failure analysis, and operational systems or topics and/or principles and practices of chemical engineering.

2.6.2. Pyrotechnics (PYRO) [18]

Knowledge of the composition, nature, applications and handling of devices or assemblies containing or operated by propellants or explosives. Involves design and development of such systems for aerospace applications, as well as study of the safe operation and maintenance of the materials and systems. Includes knowledge of fluid and mechanics, thermodynamics, materials, chemistry and physics, structures, mechanical drawings, manufacturing processes and explosive material properties.

2.7. Computer Sci & Info Technology

2.7.1. Communication Networks & Engineering (COMNETENG) [60]

Knowledge and practices associated with researching and developing air and space communications architectures and networks to meet mission and system requirements, and to research new technology for improving air traffic management and communication between satellites, flightcraft, spacecraft and ground. Includes knowledge of communication systems electronics engineering for sending and receiving signals with different networks, including wireless, digital and radio frequency bandwidths. May involve ability to make effective, efficient, and prudent use of the radio spectrum in the best interest of the Nation, with care to conserve it for uses where other means of communication are not available or feasible.

2.7.2. Computer Systems and Engineering (COMPSYSENG) [80]

Knowledge of the design and development of computers and robots. Involves design of hardware, software, networks and processes to solve technical problems such as analyzing flight systems and aerospace data. Utilizes advanced technologies such as virtual reality, artificial intelligence, and automation. Includes knowledge of computer programming, electronics, mathematical models, and neural and other networking systems.

2.7.3. Data Acquisition, Management and Storage Systems (DAMSSYS) [83]

Knowledge of design, development and implementation of large-scale scientific data storage, access, retrieval and mining systems or techniques. Includes ability to transfer research algorithms into processing code that produces scientific data products for the science community. Includes knowledge of image methods and procedures for automated feature extraction from large data sets.

2.7.4. Data Visualization (DATAVIS) [87]

Knowledge capabilities and practices associated with extracting information and knowledge from extremely large data sets through interactions with visualization systems. Capabilities include developing and using advanced data visualization systems for data mining, pattern recognition and feature extraction for application to earth and space science data sets, as well as large engineering data sets for aviation and space systems. Also involves knowledge of state-of-the art modeling and simulation techniques and hardware for interpreting data and translating the data into animated images for use in scientific and education contexts. Includes understanding of computer science, digital animation three dimensional modeling, video generation and other data representation techniques. Also involves aesthetic skills in creating renditions of data with the power to communicate meaning.

2.7.5. Intelligent/Adaptive Systems (IASYS) [85]

Knowledge of research and development techniques involving autonomous reasoning, human-centered computing and intelligent systems for data understanding towards mission requirements. Possesses knowledge of the practices associated with creating advanced intelligent, self-monitoring and adaptive computer science systems for use in development of aerospace vehicles (including unmanned systems), enhancement of aerospace flight safety and efficiency, and understanding of scientific data. Includes knowledge of techniques of artificial intelligence, virtual reality, automated software engineering, and collaborative and assistant systems, as well as understanding of vehicle health management

2.7.6. Network Systems and Technology (NETSYS) [81]

Knowledge of how to research and implement high-speed wide area networks, including technology development to allow very advanced networks to allow data, audio and video communication. This includes electrical, optical and wireless transmission, telemetry and modeling, simulation of communication systems, and emulation of flight systems, sensors and data acquisition systems to function in an optimal fashion for distributed science and engineering applications. Involves technical skills used in the development and application of computer networks and Internet technology, including switching/routing technology, network architecture, and network security.

2.7.7. Neural Networks & Systems (NEUNETSYS) [84]

Knowledge, capabilities, and practices of synthesizing practical implementations of artificial neural networks for application to NASA missions, programs, and projects. This includes such applications as machine learning algorithms and pattern recognition systems for intelligent flight control systems, complex spacecraft docking capabilities, and instrument control mechanisms.

2.7.8. Robotics (ROBOTICS) [79]

Knowledge of engineering, design, development, analysis and testing of robotic and robotic/human systems, including telerobotics. Includes knowledge of operational impacts and sustaining engineering on the system.

2.7.9. Software Engineering (SWENG) [82]

Knowledge and ability to apply systematic, disciplines and quantifiable approaches to the acquisition and development of software systems for spaceflight, ground support, airborne and facility applications. Development and management of simulations, tools and integrated software development environments for the design, development, verification, testing, manufacture, operation and maintenance of such systems. Specialized knowledge to predict, evaluate and manage critical performance attributes of software-intense systems such as real-time response and embedded hardware-driven resource limits. Includes knowledge of high-performance computing, graphical user interfaces, networking, data integrity and security.

2.8. Electrical & Electronic

2.8.1. Avionics (AVIONICS) [21]

Knowledge of research and engineering of real-time digital electronic avionics systems that use data acquired from sensors and instruments and processes it to determine status of systems for aircraft and spacecraft for such purposes as flight control, flight path management and vehicle health monitoring. Includes knowledge of design and development of computational hardware and software networks and interfaces, electrical integration, power distribution and electrical systems engineering.

2.8.2. Electro-Mechanical Systems (ELMECHSY) [15]

Knowledge of and ability to design, develop, test, integrate and evaluate electro-mechanical systems such as; gimbals, cryogenic mechanisms, smart structures, and magnetic bearings, solar array drive systems, choppers, shutters, scanning, and focusing mechanisms. Has capability to perform the complete engineering lifecycle on systems for the drive, sensing, and control of precision flight instruments, and spacecraft subsystems.

2.8.3. Electrical and Electronic Systems (ELSYS) [13]

Knowledge of engineering design and analysis, development and research of electrical systems and components for air, space and ground systems and instruments. Includes knowledge of electrical integration (cable design/development/testing) such as electrical / electronic design requirements definition, subsystem and circuit analysis, test procedure development, and safety analysis. Includes knowledge of analog and digital electrical systems engineering, EEE parts, electronic packaging design and tools, reliability and environmental effects, power generation, distribution, storage and conditioning systems. Knowledge of thermal analysis of printed circuit boards and use to analyze data to optimize design of flight electronics.

2.8.4. Flight and Ground Data Systems (FLTGNDSYS) [19]

Knowledge of integration of systems for commanding and monitoring communications for aerospace vehicles, payload flight systems and related ground equipment. Understanding of processing techniques and requirements for housekeeping, health and status, operational and science data for spacecraft and science instruments. Includes knowledge of data computational, acquisition, storage and distribution systems; special purpose analog/digital data handling and unique interface applications software. Assumes broad understanding of IT, electronics and communications disciplines and an ability to integrate the pieces together to optimize the location, design and integration of flight and ground hardware and software.

2.8.5. Control Systems, Guidance & Navigation (GNC) [22]

Knowledge of and ability to develop analytical, computational, and experimental methods for control/guidance algorithms, and apply research to develop requirements for control and instrumentation systems; establish component and systems; and use analytical modeling and simulation tools that determine control dynamic solutions. Knowledge of research and engineering of integrated aerospace vehicle systems for the guidance, navigation, and control and health management of flight vehicles in the atmosphere and space. Includes knowledge of sensors and avionics, flight dynamics, mathematical modeling, experimental methods and a broad array of engineering disciplines.

2.8.6. Micro-Electromechanical Systems (MICELM) [16]

Knowledge, capabilities and practices associated with the research, design, development, test, evaluation, application and manufacture of MEMS technologies, including microfabrication, microsystem design and integration, modeling, and packaging.

2.9. Power & Propulsion

2.9.1. Advanced In-Space Propulsion (ADVPRO) [72]

Research, development, design, testing and evaluation of propulsion technologies, such as nuclear propulsion, and space power generation systems to dramatically improve every aspect of in-space propulsion. Specialty knowledge in specific technologies such as nuclear propulsion, high powered electrical, solar voltaic, fuel cells, solar dynamic, and propellantless propulsion such as electrodynamic tethers and beamed energy.

2.9.2. Airbreathing Propulsion (AIRPRO) [69]

Knowledge of technologies and concepts for airbreathing propelled vehicles in order to enhance the safety of operations, reduce lifecycle costs, contribute to reduced costs of air travel and access to space, and reduce carbon dioxide emissions. Includes knowledge of various engine cycles, flight conditions, efficient mixing and combustion, various materials, and reliable design tools for aerodynamic and propulsion system design and performance prediction, as well as application of combined cycle systems to advanced propulsion techniques.

2.9.3. Hypersonic Airbreathing Propulsion (HAIRPRO) [70]

Knowledge of research and testing activities associated with hypersonic airbreathing propulsion flowpath and its integration with the vehicle concepts. Includes knowledge of the physics of high speed fuel-air mixing and combustion. Ability to plan, conduct, and interpret results of experimental and computational investigations to derive engine performance. Inherent within this competency is also the ability to design and develop engine components (inlet, combustor, and nozzle) and their interaction.

2.9.4. Hypergolic Systems (HYPERSYS) [71]

Knowledge, capabilities and practices associated with hypergolic propellants and propulsion systems. This includes handling characteristics, material properties, system safety, and system unique requirements for the safe and effective test, implementation, and operation of hypergolic systems for research, development, design, analysis, testing and/or evaluation.

2.9.5. Nuclear Engineering (NUCLEARENG) [138]

Knowledge of scientific and engineering principles associated with the safe design and operations of terrestrial and non-terrestrial nuclear reactor systems and radioisotope decay power systems. Knowledge and practice of neutron fission and decay of nuclear material, radioactivity determination/calculation/shielding due to fission and decay of nuclear materials, thermodynamics, nuclear/quantum physics, materials science, operations and control principles of nuclear reactors, simulation of reactor operations, health-physics effects of reactor radioactivity on humans, and probabilistic risk assessment. Ability to develop design concepts for potential nuclear propulsion systems, evaluating proposed designs and doing tradeoffs to determine which concepts can be incorporated into future space missions.

2.9.6. Propulsion Systems & Testing (PROSYS) [68]

Knowledge of conceptual aeropropulsion and aviation systems analysis and testing to assess the benefits of propulsion systems, subsystems and components over all flight regimes from general aviation through space access. Knowledge of the integration of component technologies into conceptual systems. Includes research, design, testing, and evaluation of components systems such as combustors, inlets, nozzles, and turbomachinery, emissions, engine materials and structures, propulsion controls, and propulsion airframe integration. Knowledge of advanced, distributed instrumentation for acquiring improved information in a hostile engine environment. Experience in advanced methods for safe and affordable rocket propellant testing.

2.9.7. Power - Energy Storage (PWRENG) [76]

Knowledge, capabilities, and practices associated with the design, development, test, and evaluation of battery, flywheel, fuel cell, membrane technology and other electrical power storage components and systems.

2.9.8. Power Generation - Photovoltaics (PWRPHO) [77]

Knowledge, capabilities, and practices associated with the design, development, test and evaluation of photovoltaic power generation systems, including electric actuation and solar cell/array systems.

2.9.9. Power Systems (PWRSYS) [75]

Applies knowledge and capabilities involved in the design, development, test, and evaluation of hardware for power generation, storage, conditioning and distribution for all vehicles, spacecraft, and experiments. Inherent within this is a broad knowledge of power sources and technologies and the ability to develop power architectures and integrate all elements into networked systems tailored to their specific environments. Also includes development, test and evaluation of the impact of environments and material on power systems.

2.9.10. Power Generation - Thermal Systems (PWRTHM) [78]

Design development, test, and evaluation of dynamic power systems including thermal and solar dynamic systems.

2.9.11. Rocket Propulsion (ROCPRO) [73]

Knowledge of research and testing activities associated with liquid and solid rocket propulsion. Includes knowledge of combustion devices, cryogenic tanks, engine systems, and propulsion system subcomponents such as gas generators, thrust chambers, turbopump assemblies, valves, propellant ducts, and auxiliary propulsion systems, as well as application of combined cycle systems to advanced propulsion techniques.

2.10. Sensor Systems

2.10.1. Sensors & Data Acquisition - Aeronautics (AEROSEN) [20]

Knowledge, capabilities and practices associated with sensors and data acquisition systems, particularly for use in flight vehicles, payloads and/or associated ground support equipment processes, such as propulsion system sensing or vehicle health management. This includes knowledge of sensing characteristics and properties, data acquisition and data processing characteristics and properties, and system unique requirements for the safe and effective implementation of sensors and data acquisition usage in aerospace systems.

2.10.2. Detector Systems (DETECTSYS) [96]

Knowledge, capabilities, and practices related to the research, design, development, characterization, and application of detectors and detector systems with an emphasis on remote sensing applications. Includes research and development of advanced detectors and detector systems covering a wide spectral range to include UV, visible, IR, and microwave. Also includes the design, development, test, characterization, and integration of detectors and detector systems into a variety of applications with an emphasis on remote sensing systems.

2.10.3. Electron Device Technology (ELDEVTEC) [14]

Knowledge and practices associated in conducting research and development of electron device technology for communications component and systems such as microwave devices, MEMS and MMICs.

2.10.4. Electromagnetics (ELMAG) [12]

Knowledge, capabilities, and practices associated with research and technology in analytical, computational, and experimental methods to quantify and control complex electromagnetics phenomena to address issues such as electromagnetic interference, electromagnetic compatibility, electrostatic discharge, and advanced integral/conformal antennas. Also includes engineering design of systems and how they will react given electromagnetic fields, compatibility, interference and discharge.

2.10.5. Laser Technology (LASER) [92]

Knowledge of high performance, high reliability lasers and laser systems for measurement of essential planet atmospheric variables including aerosols, water vapor, ozone, wind velocity, green house gasses, ozone, and metrology applications such as ice cap thickness, as well as medicine and manufacturing technologies. Able to apply subspecialty knowledge to research crystal materials and their frequencies, and design highly precise laser systems (such as those tunable and stable to a part per million with high spectral purity, in double pulse format with multibillion shot lifetime) that can withstand both launch and the rigors of deployment in space.

2.10.6. Microwave Systems (MICROSYS) [94]

Applies knowledge and practices associated with the design, analysis, development and test support for devices utilizing advanced technology for instrument (including data system) and communications (including telemetry) applications. Includes knowledge and capability in one or more of the following areas; antenna systems for general electromagnetic components, communications systems for space, suborbital, aircraft, and ground applications, instrument systems (both active and passive) for space, suborbital, aircraft, and ground applications, and systems and components for instrument, communication, telemetry, and radar applications.

2.10.7. Optical Systems (OPTSYS) [93]

Applies principles and practices related to the research, design, development, test, and evaluation and/or operation of optical components and systems, including optical sensors and optical data/image processing. Inherent within this competency is knowledge, capabilities, and practices associated with mechanically and digitally based optical instruments and associated measurement systems required to support siting, construction, assembly or operation of facilities, flight vehicles, payloads, infrastructure, and/or associated ground support equipment and processes. This includes the knowledge of light and optical theory and its application, surveying techniques; measurement equipment operation, care and calibration; measurement data acquisition and data processing techniques; and system unique requirements for the safe and effective implementation of data acquisition in a wide variety of systems.

2.10.8. Remote Sensing Technologies (RST) [95]

Knowledge and ability to conceive, develop and evaluate active and passive remote sensing and detector systems to measure atmospheric constituents including ozone, water vapor, aerosols, and trace species; cloud physical and microphysical properties; wind velocity; and spectral radiation. This includes advanced flight-qualified laser systems, optical components, microwave systems, radiometric sensors, and other remote sensing instruments as well as associated component subsystems, detectors, calibration systems, and data acquisition systems. Assumes a broad understanding of specialty areas such as Laser, Lidar or Optics technologies.

2.11. Structures, Materials & Mechanics

2.11.1. Analytical and Computational Structural Methods (ACMSTR) [64]

Research knowledge, capability, and practices for developing computationally efficient methodologies for structural modeling, analysis, and design, for predicting response, damage tolerance, and residual strength of aerospace structures using nonlinear structural analysis methods and models, for developing validated finite element methods for special purpose computational methods including rapid optimal structural sizing, for developing analytical models for radiation protection and shielding, and for developing multi-sensory, visually immersive simulation and design methodologies for enhanced understanding and collaboration. Involves in-depth understanding of mathematics and computer science.

2.11.2. Advanced Materials and Processing Science (ADVMATSCI) [65]

Research knowledge, capabilities and practices associated with the synthesis, structure, processing and properties of materials, from atomic to macroscopic, including the behavior and mechanisms by which types of materials react to stresses, processes and environments, particularly the harsh environment of space. Includes experimental research into materials such as electronic materials, glasses and ceramics, metals and alloys, lubrication materials, sealants, foams, composites and polymers for improving current and enabling future aerospace applications. . Includes computational research to develop validated structure-property relationship models for all classes of materials. Includes processing, testing, and characterizing these materials to further understanding of how they can be combined or treated to improve the quality and reliability of systems, control defects and prevent contamination of operating systems or components.

2.11.3. Materials Engineering (MATENG) [66]

Knowledge capability and practices associated with research into the characteristics and performance of materials and the design, development and testing of those materials within aerospace structures such as flight systems, ground support and facility systems. Includes the development of math models for assessment of material durability and response to environmental conditions and contaminants. Includes broad knowledge of materials disciplines, including material types such as ceramics, metallics, and polymers as well as tribology or surface science.

2.11.4. Mechanics and Durability (MECDUR) [62]

Research knowledge, capabilities, and practices for quantifying complex aerospace material and structural responses under combined loading and environmental conditions, for investigating the expected lifetime performance, damage tolerance, and reliability of materials and structures, for developing mechanics-based multifunctional materials and structures technologies through characterization, analytical modeling, and simulation, for developing hierarchical models to conceive reliable and safe concepts that are efficient, tailored, high precision, and deployable, and for conceiving, developing, and implementing novel test methods, techniques, and measurement technologies for validating advanced concepts and approaches. Includes the ability to conduct mass properties analysis.

2.11.5. Mechanical Systems (MECSYS) [17]

Knowledge, capability and practices involving the design, development and testing of vehicle and instrument structures, mechanisms deployment systems, associated mechanical ground support equipment and facilities structures. Includes knowledge of mechanical requirements development; mechanical system interfaces among instruments, subsystems, vehicle and ground systems; vehicle and instrument manufacturing and assembly; and vehicle and instrument alignment techniques and qualification testing. Includes knowledge of manufacturing techniques, materials, mechanical and materials standards, parametric computer aided design, mechanisms design, basic structural analysis, and knowledge of the state of best practice for complex mechanical systems.

2.11.6. Non-destructive Evaluation Sciences (NDESCI) [67]

Research knowledge, capabilities, and practices for developing and applying advanced sensors, health monitoring technologies, computational techniques, and NonDestructive Evaluation (NDE) methodologies, e.g., x-ray, ultrasonic, eddy current inspection, to characterize advanced materials and structures, for developing intelligent, autonomous micro and nano-methods for characterization, health monitoring, control, and self-repair of aerospace systems, and for developing techniques and concepts for nondestructive flaw detection, manufacturing process control sensing, and instrument system miniaturization.

2.11.7. Structural Systems (STRSYS) [63]

Knowledge, capability and practices associated with using and modifying advanced analytical and computational methods to design, develop, test and research the characteristics and performance of structures. Includes the development of structural math models for and comprehensive assessment of air, space and ground structures, the analysis of the models to determine structural response to multiple external and internal environmental conditions, and analysis of flight and test data for structural systems. Includes broad knowledge of structures disciplines including structural dynamics, structural mechanics, structural acoustics, mechanisms, electro-mechanical devices, aeroelasticity, impact, damage tolerance and structural life prediction. Also involves research into measurement, instrument and test systems to assess structural characteristics and risks, and ensure system integration.

2.11.8. Structural Dynamics (STUDYN) [61]

Research knowledge, capabilities and practices for developing and analyzing methods to predict, verify and control structural dynamic response for aerospace structures and components including payloads, launch vehicles and propulsion systems. Involves ability to develop high fidelity integrated mechanical three-dimensional models to simulate system behavior and to provide a more thorough understanding of interactions between structures and the motion of mechanisms.

2.11.9. Thermal Structures (THMSTR) [105]

Research knowledge, capabilities, and practices for designing, developing, analyzing, and validating thermal-structural concepts for aerospace systems subjected to extreme operational environments and for developing design technology for thermal-structures applications and for multiscale optimization of metallic materials, structures, and fabrication processes.

2.12. Thermal/Fluid

2.12.1. Cryogenics Engineering (CRYOENG) [26]

Knowledge, capabilities and practices associated with aerospace cryogenic systems, particularly for use in propulsion, life support, refrigeration and laboratory processes. This includes handling characteristics, material properties, system safety, and system unique requirements for the safe and effective usage of cryogenic fluids for research, development, design, analysis, test, operation and/or evaluation of cryogenic fluids storage and transfer systems for both fuels and oxidizers.

2.12.2. Fluid Systems (FLDSYS) [106]

Knowledge, capabilities, and practices associated with basic fluid physics research (including microgravitational study of complex fluids, multiphase and phase change, fluid dynamics and instabilities, and interfacial phenomena), as well as modeling and development, design, integration, analysis, test, operation and evaluation of aerospace ground and flight closed fluid systems. Knowledge of assessment of requirements, establishment of specifications and evaluation to insure proper function and compatibility of fluid systems hardware/components. Also includes integration of control logic and control systems design to ensurea fully functional process system, and design and development of instruments for imaging fluid leaks, evaluating sensitivity, vibration susceptibility and field usability to ensure safe implementation, particularly for fluid power systems. This requires the basic knowledge and skill of mechanical design, fluid physics, fluid mechanics, component design, and integrated system layouts / designs and evaluation of their capability to satisfy functional and performance requirements.

2.12.3. Fluid Physics (FLUIDPHY) [43]

Employ knowledge of the motion of fluids and the effects of such motion, to the understanding, control and improvement of industrial and natural processes. Areas of research include microgravitational study of complex fluids, multiphase and phase change, fluid dynamics and instabilities, and interfacial phenomena.

2.12.4. Thermal Systems (THMSYS) [104]

Knowledge, capabilities and practices associated with heat transfer, fluid flow, and thermodynamics in the design, development, testing, integration and evaluation of passive and active thermal control systems for spacecraft, instruments, experiments, sensors, aircraft, ground systems, thermal protection systems and facility systems. Includes knowledge and practices in the development of advanced thermal hardware and thermal technology for future spacecraft, instrument, and sensor applications including heat pipes, two-phase heat transfer systems, cryogenic systems, advanced coatings, and heat pumps. Includes knowledge of the development of math models for low and high speed convection, conduction, radiation, ablation and aeroheating.

2.13. Multi-disciplinary R&D

2.13.1. Advanced Analysis and Design Method Development (AADMD) [91]

Enable the mission and system analysis and technology trades for advanced aerospace system concepts. Knowledge of systems analysis methods for use in performing conceptual analysis and design of aerospace systems. Knowledge of multidisciplinary design optimization methods for use in preliminary and detailed engineering analysis and design of aerospace vehicles and spacecraft (including design, manufacturing, and operations).

2.13.2. Advanced Measurement, Diagnostics, and Instrumentation (ADVMDI) [111]

Knowledge, capabilities, and practices associated with research and development, assessment, implementation, and integration of advanced measurement, flow diagnostics, instrumentation to understand and discover flow physics, to develop and validate physical/chemical models, and to support aerodynamic, aerothermodynamic, acoustic, and hypersonic airbreathing propulsion design and analysis of aerospace vehicles in ground facilities and in flight. Inherent within this competency is also the ability to resolve issues arising from test articles, data systems, and integrated measurement systems and their interactions.

2.13.3. Advanced Experimentation and Testing Technologies (AETT) [109]

Knowledge of advanced experimentation and testing philosophies and approaches that provide results to inform research activities in specialized areas such as structures, materials, airborne Systems, aerodynamics, and propulsion. Ability to develop and use specialized facilities and equipment such as wind tunnels, and laboratories. Includes knowledge of how to plan, conduct and interpret experimental test results to understand the interaction of test elements on the design of current and future aerospace vehicles. Also involves ability to develop, manage and enhance test processes to optimize productivity, cycle time, data quality, cost and customer satisfaction.

2.13.4. Mathematical Modeling & Analysis (MMA) [86]

Knowledge, capabilities and practices associated with mathematical modeling, the design of algorithms and applied computational methods, simulation and analysis of physical systems to represent structural, fluid, thermal, dynamic, chemical, or other real phenomena in a quantifiable manner. This includes using manual calculations and computer simulation software. Models can refer to launch vehicle, spacecraft, ground support equipment, handling equipment, and facility/flight interface hardware related physical systems design of algorithms and applied computational methods. This includes capability in the area of quantum computing. Understanding of the physical principle represented in the model is essential to this competency.

2.13.5. Nanotechnology (TINYTEC) [57]

Knowledge of the study of characteristics and properties of extremely small materials for development of new capabilities and applications in support of agency missions, programs and projects such as advanced structures, storage capabilities and computer systems. Includes an understanding of how to apply nanoscience findings, and a broad knowledge of other research and engineering disciplines.

3. Mission Operations Competencies

3.1. Mission Operations

3.1.1. Advanced Technical Training Design (ADVTEC) [3]

Knowledge of state-of-the art practices required to train technical personnel such as flight crew or ground support to accomplish objectives for near-term or futuristic missions. Identify training objectives, design training plans, tools, curricula and simulations using advanced techniques. Involves knowledge of instruction providers and tools, and how to employ and assess these resources.

3.1.2. Mission Assurance (MA) [30]

Knowledge of methodologies and practices such as risk identification, analysis, planning, tracking and control (e.g., Certificate of Flight Readiness process, product management process) used to achieve mission, product or process success. Activities include independent verification of product design requirements, testing validation, critical inspections, facility evaluations, flight safety analysis, development of recommendations, and tracking corrective actions.

3.1.3. Mission Execution (MISEXC) [4]

Knowledge, capabilities and practices associated with the execution of missions, including pre-launch, launch, in-orbit and recovery operations for space flight, or conducting safe, efficient and effective operation of research or training aircraft. Manage command and control activities, payload integration and operations, robotic operations and EVA operations according to mission objectives including the technical activities and real-time decision -making and problem resolution during mission critical operations.

3.1.4. Space Medicine (SPAMED) [36]

Ability to practice medicine involving the unique aerospace environment. Ability to diagnose and provide medical care during pre-flight, in-flight, and/or post-flight operations. Awareness of countermeasures that are in the development and validation process as well as the application of such validated countermeasures.

3.1.5. Vehicle Processing & Payload Integration (VPPI) [5]

Applies knowledge and practices of management, science and engineering to lifecycle of all payload research experiments. Ability to optimize use of existing systems for accomplishment of science objectives, and to determine engineering requirements such as payload support hardware definition, design, fabrication, integration and testing, and operating procedures. Includes ability to integrate payloads into vehicles and determine requirements and predict operating impacts between payloads and vehicles. Ability to test and process payloads, and integrate them successfully on-board the vehicle.

3.1.6. Weather Observation and Forecasting (WOBSFR) [6]

Knowledge, capabilities and practices associated with developing or improving techniques for observing or forecasting local weather conditions in a coastal, semi-tropical environment. Specific capabilities include high resolution in-situ or remote sensing of wind, temperature and humidity; mesoscale meteorological modeling; high-resolution measurement of atmospheric electric fields and charge; radar meteorology; theoretical or numerical modeling of free electric charge generation and dissipation in clouds; and related areas. It also includes developing concepts of operation for the application of these technologies to Range operations; identifying and evaluating deficiencies in operational weather support for new or existing requirements; understanding the impact of meteorological variables on Range operations and systems; and knowledge of the application of weather data and technologies to the design of operational systems and procedures.

3.2. Quality/Safety/Performance

3.2.1. Quality Engineering & Assurance (QEA) [29]

Knowledge, capabilities, and industry/government standards and practices associated with the assurance of quality (aeronautic and astronautic) for all phases of the mission life-cycle including design, manufacturing, assembly, testing and operations. Capability for planning, defining, and documenting quality requirements for products, processes, and systems that are suitable to the activity, proportional to the risk, and consistent with established NASA guidance, practices, and standards including NASA workmanship standards, NASA parts standards, and NASA recommended practices for contract quality and supplier assessment. Knowledge of ISO 9000 and AS 9100 series of quality standards, and the use of these standards for complex or critical items when technical requirements require control of such things as work operations, in-process controls, and inspection; or attention to such factors as organization, planning, work instructions, documentation control, and advanced metrology.Knowledge of surveillance methods which can range from a one-time test or inspection of a product or service to periodic in process monitoring of on-going contract performance. Ability to assess ongoing performance to ensure the quality of supplies or services received based on the risk, size, time period, and the performance requirements and standards that have been specified. Ability to perform, manage, and/or evaluate the results of operational quality activities (audits, surveys, reports, acceptance data package/test report, etc.) performed by NASA, NASA designated representatives, other delegated agencies, and/or third party certification bodes. Ability to continually improve quality through advocacy and dissemination of advanced quality tools, techniques, technology, practices, policy, procedures, and training (such as practices for ISO 9001/AS 9100, six-sigma, continual improvement, process control, and others).

3.2.2. Reliability & Maintainability Engineering & Assurance (RMEA) [28]

Knowledge, capabilities and practices used to design flight, ground support, and facility systems, equipment and instruments for performing their intended function for a specified interval under stated conditions (reliability) and/or have a defined capability to be restored to operational status following a failure (maintainability). Capabilities include the capacity to: define mission success criteria; define and evaluate compliance with systems/equipment reliability/maintainability requirements, including redundancy requirements; model systems/equipment from a reliability/maintainability perspective, including allocations and predictions; perform and evaluate quantitative and qualitative analyses and assessments, including failure modes and effects analyses/critical items list, probabilistic risk assessments, limited life items, quantitative computations; perform and evaluate statistical analysis, trending, and trade-offs; perform and evaluate maintenance analyses, such as reliability centered maintenance techniques; plan, perform and evaluate laboratory testing and engineering analyses; evaluate system/equipment failures to determine root cause and develop corrective actions to prevent similar failures in the future; integrate reliability/maintainability requirements, activities and results with other related disciplines (competencies) such as Safety Engineering and Assurance, Risk Management, Quality Engineering and Assurance, Human Factors, Software Assurance, Acquisition and Contract Management, and Logistics. Also includes availability which can combine the elements of reliability and maintainability in a single parameter."

3.2.3. Safety Engineering and Assurance (SAFENG) [27]

Knowledge of scientific, engineering and management principles for ensuring safety of missions and systems through controlled design, development and operation. Includes ability to use analytical tools such as failure modes and effects analysis, fault tree analysis, probabilistic risk assessment and hazard analysis, and develop technical reports of results, conclusions, and recommendations. Apply criteria and techniques such as safety audits, assessments, inspections, and sampling to identify and eliminate/mitigate hazards and achieve an acceptable level of risk, within the constraints of operational effectiveness and suitability, time, and cost throughout all phases of the system life cycle.

3.2.4. Software Assurance Engineering (SWASSURANCE) [139]

Knowledge, capabilities and practices associated with the planning, organizing, performing, monitoring and directing software assurance activities for software acquired and developed for all phases of the product lifecycle including product concept, acquisition, contractor selection and oversight, requirements, design, implementation, problem reporting, corrective action, verification and validation, testing, operations, maintenance, and retirement. SA practices include software product assurance, process assurance, quality, reliability, safety, security, risk management, verification, validation, and independent verification and validation. Additionally, demonstrate knowledge of current software and systems engineering practices, languages, management, planning, standards, procedures, and recommended processes. Assures that process and product standards are appropriate, implemented correctly, followed, and improved.

4. Program/Project Management Competencies

4.1. Program/Project Management

4.1.1. Program/Project Analysis (PROJANALYSIS) [147]

Knowledge, capabilities and practices associated with formulating, planning, implementing, tracking and evaluating work and its associated requirements and risks, ranging from one-time projects to program-level work. Critical ability is to develop, analyze, and oversee resources, schedule, and management controls needed by the Program/Project manager to achieve the appropriate balance between resources, schedule, and technical objectives. Includes knowledge associated with finance, budgeting, schedule, configuration management, and project controls.

4.1.2. Program/Project Management (PROJPROGMT) [122]

Knowledge, capabilities and practices associated with formulating, planning, implementing, managing, tracking and evaluating work and its associated requirements and risks, ranging from one-time projects to program-level work. Critical abilities are to define customer and stakeholder needs and constraints, reduce ambiguity in objectives, develop and manage an efficient project organizational structure, and apply system architecture principles to develop and manage technical requirements in order to achieve the appropriate balance between resources, schedule, and technical requirements. Includes knowledge associated with system architecture, finance, budgeting, risk assessment, schedule, configuration management, contract technical management, and project controls.

4.1.3. Risk Management (RISKMMT) [123]

Knowledge, capabilities and practices associated with the decision process associated with mitigating or accepting risks. This includes knowledge of fundamental risk management concepts, Continuous Risk Management (CRM) implementation in programs/projects, Risk-Based Acquisition Management (R-BAM) implementation for major procurements that require formal acquisition planning, and ongoing assessment of program/project risk management activities.

5. Science Competencies

5.1. Space Sciences

5.1.1. Astromaterials, Collections, Curation & Analysis (ASTANA) [55]

Apply knowledge of foreign materials, and planetary sciences to the collection of materials from foreign planets, and developing and using appropriate processes for handling and curating them. Includes knowledge and skill in processing the materials to protect Earth system from contamination.

5.1.2. Astrobiology (ASTBIO) [54]

Apply knowledge of biology, chemistry, physics, and other sciences in interdisciplinary experimental, observational, theoretical, and modeling studies of the origin, early development, and transmission of life in or on astronomical bodies and media, including the Earth and its atmosphere, and to determine how and where life arose and evolved on Earth and elsewhere, with due regard to environmental conditions and limits.

5.1.3. Astronomy & Astrophysics (ASTRO) [52]

Knowledge of the fundamental processes of radiation and dynamics for the study of the structure and composition of the Solar System, other planetary systems, stars and stellar systems, galaxies, and the structure and evolution of matter and cosmology. Use a variety of observational methods, data analysis techniques and theoretical models to characterize the physical and dynamical states of celestial objects, determine formation history and predict future evolution. Use physics and chemistry knowledge to conduct observational and theoretical studies and modeling of stars, nebulae, galaxies, and systems of stars and galaxies, and of circumstellar, interstellar and intergalactic media, particles, molecules and radiation fields, in all electromagnetic wavelength ranges. Includes study of specialty areas such as Gamma Ray & X-Ray Astronomy and Cosmic Ray Astrophysics, in which electromagnetic waves, x-ray emissions and cosmic ray particles provide data for examining the content, structure, origin and evolution of space elements.

5.1.4. Atmospheric Science (ATMSCI) [44]

Knowledge of the fundamental processes of radiation, chemistry and dynamics in the study of the structure and composition of the Earth's atmosphere. Conceive and implement a variety of observational methods, data analysis techniques, and theoretical models to characterize the state of the atmosphere, detect variability and explain the responsible forcing mechanisms, and predict the future state of the atmosphere. Able to develop and implement missions to conduct atmospheric research, and contribute to the development of atmospheric instrument and sensor development. Includes subspecialty knowledge in areas such as Radiation and Climate, Stratospheric & Tropospheric Chemistry.

5.1.5. Planetary Science (PLASCI) [53]

Knowledge of space science applied to conducting experimental, observational, and theoretical studies and modeling of planets, planetary satellites, asteroids, comets, meteoroids, and other objects, media, and particles in the solar system, in order to determine their composition and properties in such areas as atmospheres, magnetospheres, lithospheres, cryospheres, and interiors.

5.1.6. Space Physics (SPAPHY) [51]

Uses knowledge to conduct experimental, theoretical, and/or applied physics and modeling relating to matter, radiation, and their interactions, and ranging from elementary particles and fields to atomic, and nuclear physics, condensed matter physics, optical, gravitational and quantum mechanical, hydrodynamical and magnetohydrodynamical physics and General Relativity, and as applied to the nature and structure of the universe and to chemical, biological, and geophysical systems. Includes specialty areas such as solar physics, involving use of observational and experimental studies to model the Sun and its magnetic activity, characteristics, composition and influence on the Earth and other planetary bodies, as well as space plasma physics, focused on near-Earth environments such as the magnetosphere and its properties.

5.1.7. Terrestrial & Space Environmental Science and Engineering (TSENV) [23]

Knowledge of composition, elements, behaviors and impact of the terrestrial and space environments on the design, development, testing and operation of systems and components for aerospace vehicles and satellites. Involves understanding of atmospheric variables such as wind profiles, turbulence, cloud cover, ice/frost formation, and space characteristics such as ionizing radiation, plasma, meteoroids & super-charged orbital debris, solar and thermal environments. Involves the ability to perform analyses to define the environments, quantify their effect on space craft design, development and operations and perform trade-off studies to optimize performance and assess risk.

5.2. Earth Sciences

5.2.1. Biology and Biogeochemistry of Ecosystems (BBECO) [46]

Apply knowledge of biology, biogeochemistry of ecosystems and the global carbon cycle to research, understand and predict how terrestrial and marine ecosystems change. Research ecosystems as they are affected by human activity, and as they change due to their own intrinsic biological dynamics, and as they respond to climatic variations and, in turn, affect climate. Emphasis is on an understanding of the processes of the Earth system that affect its capacity for biological productivity, explain the role of the biosphere in Earth system function, and promote proactive ecological stewardship. Ability to understand, study and properly document changes in land cover and land use.

5.2.2. Earth Science Applications Research (ESARES) [49]

Use knowledge of Earth systems and measurement technologies for designing research into Earth Science disciplines that have the objective of improving the quality of life on Earth and the longevity of the planet. Apply research to such subjects as resource and disaster management, environmental assessment, human health and safety, food and fiber, infrastructure planning, and environmental quality.

5.2.3. Earth System Modeling (ESMODEL) [50]

Apply understanding of Earth systems to consolidation of scientific findings into integrated representations of atmosphere, ocean, ice land and biosphere systems, with the ability to predict future system trends and evolution of chemical and biological components.

5.2.4. Geophysical/Geologic Science (GEOSCI) [45]

Knowledge of a wide range of disciplines related to the earth's composition, its fluid envelopes, and its position in space. Apply concepts and methods in mathematics, physics, chemistry, and biology to the problems of the atmosphere, the oceans, the solid earth, and the evolution of the planet. Involves ability to conduct far-reaching studies of the origin of the earth and solar system.

5.2.5. Geospatial Science and Technologies (GST) [88]

Applies knowledge and practices of geospatial science and has the ability to utilize and/or develop the tools for acquiring, storing, analyzing, and outputting data in multiple dimensions, as referenced to the earth by some type of real-world coordinate system (eg, a map projection). The ability to reference a geographic location as an important component in the analyses of effects or trends in biological and physical socio-economic resources. Understanding of and ability to use a variety of technology tools, such as geographic information systems (GIS), remote sensing, thematic mapping, image processing, satellite positioning systems such as the Global Positioning System (GPS), and telemetry.

5.2.6. Hydrological Science (HYDSCI) [47]

Knowledge of the scientific study of waters of the earth, especially with relation to the effects of precipitation and evaporation upon the occurrence and character of water in streams, lakes and on or below the land surface. Includes understanding of the hydrologic cycle from precipitation to evaporation or return of the water to the seas, and application of findings to predict rates and amounts of runoff in rivers, assess required spillway and reservoir capacities, determine soil-water-plant relationships in agriculture and manage water supplies.

5.2.7. Oceanographic Science (OCESCI) [48]

Research into the composition, activities, processes and patterns in the oceans and ocean ice to increase understanding of how the marine environment interacts with the rest of the planet. Includes research on glaciers and ice sheets. Use a variety of data collection methods to collect information about the ocean and mathematically describe and predict ocean processes. Includes ability to translate data into information useful in the understanding and interpretation of the oceans themselves and their connection to other earth systems.

5.3. Physical Sciences

5.3.1. Combustion Science (BOOMSCI) [74]

Employs knowledge, capabilities and practices of study of the science of burning and burning processes, including reaction kinetics and fuels, particularly related to heat transfer, combustion and fluid flow processes by which chemical

energy is converted to propulsive power. Utilizes ground based or microgravity experiments to increase basic knowledge of combustion processes

5.3.2. Fundamental Physics (FUNPHY) [42]

Knowledge, capabilities and practices associated with research and application of electromagnetism, continuum and classical mechanics, quantum mechanics, and thermodynamics. May also include studies in materials, cryogenics, acoustics, and electromagnetic fields ranging from DC to X-ray. It also includes the development of sensors necessary to carry out these studies. Involves ability to conduct microgravitational research designed to answer basic questions about the nature and structure of the universe and its chemical, biological and geophysical systems.

5.3.3. Icing Physics (ICEPHY) [107]

Knowledge, capabilities and practices associated with researching and understanding icing physics analysis and testing, atmospheric science, and ice sensing and protection methods.

5.3.4. Nanoscience (TINYSCI) [56]

Knowledge, capability and practices to study and research extremely small materials is such areas as their structure, shape how they act, and how their properties change as their size changes.

5.4. Biological Sciences

5.4.1. Biomedical Research (BIORES) [34]

Involves the capability to research, investigate and characterize the effects of space flight and exposure to microgravity, radiation, and other stresses on physiological functions (e.g., musculoskeletal, cardiovascular, etc.). In-depth understanding of the human body, its physical and chemical make-up and the associated technology and methods to examine the effects of various environments and stresses. Ability to understand the underlying physiological, behavioral and psychological mechanisms and performance aspects responsible for biomedical and behavioral changes in humans and animals during spaceflight and apply this information to conduct operational and clinical research to develop, validate and implement countermeasures that will ensure the health, safety and performance of flight crews involved during launches, landings, and while in space.

5.4.2. Cell & Molecular Biology (CELLBIO) [31]

Knowledge of and ability to conduct research on basic cellular function and properties such as gene regulation and expression or mechanoreception, that may be directly or indirectly impacted by altered gravitational force and other space-related effects. Includes study of the dynamics of cell behavior and interactions and differentiation in cellular systems within and across organisms under a variety of environmental conditions, such as the physiological changes seen in whole animals in response to the space environment.

5.4.3. Developmental Biology (DEVBIO) [32]

Knowledge of and ability to conduct research on the processes of development, differentiation, and growth in animals and plants at the molecular, cellular, and genetic levels.

5.4.4. Neurobiology (NEUBIO) [33]

Knowledge of and capability to research and provide understanding regarding the structure, function, chemistry and development of the brain. Understanding of the techniques of molecular biology and molecular genetics and various methods for detecting and mapping the activity of individual nerve cells or groups of nerve cells.

Appendix A: Competency ID Number Cross-Reference Table

CompID	Designator	Title
1	MAP	Mission Analysis and Planning
2	FLTDSG	Mission Flight Design
3	ADVTEC	Advanced Technical Training Design
4	MISEXC	Mission Execution
5	VPPI	Vehicle Processing & Payload Integration
6	WOBSFR	Weather Observation and Forecasting
7	SYSENG	Systems Engineering
8	DESDEV	Design and Development Engineering
9	INTEGENG	Integration Engineering
10	TESTENG	Test Engineering
11	ENGSCISUP	Engineering and Science Support
12	ELMAG	Electromagnetics
13	ELSYS	Electrical and Electronic Systems
14	ELDEVTEC	Electron Device Technology
15	ELMECHSY	Electro-Mechanical Systems
16	MICELM	Micro-Electromechanical Systems
17	MECSYS	Mechanical Systems
18	PYRO	Pyrotechnics
19	FLTGNDSYS	Flight and Ground Data Systems
20	AEROSEN	Sensors & Data Acquisition - Aeronautics
21	AVIONICS	Avionics
22	GNC	Control Systems, Guidance & Navigation
23	TSENV	Terrestrial & Space Environmental Science and Engineering
24	MANUFACT	Manufacturing Engineering
25	CHEMENG	Chemistry/ Chemical Engineering
26	CRYOENG	Cryogenics Engineering
27	SAFENG	Safety Engineering and Assurance
28	RMEA	Reliability & Maintainability Engineering & Assurance
29	QEA	Quality Engineering & Assurance
30	MA	Mission Assurance
31	CELLBIO	Cell & Molecular Biology
32	DEVBIO	Developmental Biology
33	NEUBIO	Neurobiology
34	BIORES	Biomedical Research
35	BIOMEDENG	Biomedical Engineering
36	SPAMED	Space Medicine
37	ECLSS	Environmental Control and Life Support Systems
38	EAS	Extravehicular Activity Systems
39	ENVFACT	Habitability and Environmental Factors
40	FUNHUM	Fundamental Human Factors Research

Workforce Competency Dictionary

CompID	Designator	Title
41	HUMFAC	Human Factors Engineering
42	FUNPHY	Fundamental Physics
43	FLUIDPHY	Fluid Physics
44	ATMSCI	Atmospheric Science
45	GEOSCI	Geophysical/Geologic Science
46	BBECO	Biology and Biogeochemistry of Ecosystems
47	HYDSCI	Hydrological Science
48	OCESCI	Oceanographic Science
49	ESARES	Earth Science Applications Research
50	ESMODEL	Earth System Modeling
51	SPAPHY	Space Physics
52	ASTRO	Astronomy & Astrophysics
53	PLASCI	Planetary Science
54	ASTBIO	Astrobiology
55	ASTANA	Astromaterials, Collections, Curation & Analysis
56	TINYSCI	Nanoscience
57	TINYTEC	Nanotechnology
58	BIOENG	Bioengineering
59	BIOMET	Biomimetics
60	COMNETENG	Communication Networks & Engineering
61	STUDYN	Structural Dynamics
62	MECDUR	Mechanics and Durability
63	STRSYS	Structural Systems
64	ACMSTR	Analytical and Computational Structural Methods
65	ADVMATSCI	Advanced Materials and Processing Science
66	MATENG	Materials Engineering
67	NDESCI	Non-destructive Evaluation Sciences
68	PROSYS	Propulsion Systems & Testing
69	AIRPRO	Airbreathing Propulsion
70	HAIRPRO	Hypersonic Airbreathing Propulsion
71	HYPERSYS	Hypergolic Systems
72	ADVPRO	Advanced In-Space Propulsion
73	ROCPRO	Rocket Propulsion
74	BOOMSCI	Combustion Science
75	PWRSYS	Power Systems
76	PWRENG	Power - Energy Storage
77	PWRPHO	Power Generation - Photovoltaics
78	PWRTHM	Power Generation - Thermal Systems
79	ROBOTICS	Robotics
80	COMPSYSENG	Computer Systems and Engineering
81	NETSYS	Network Systems and Technology
82	SWENG	Software Engineering
83	DAMSSYS	Data Acquisition, Management and Storage Systems
84	NEUNETSYS	Neural Networks & Systems

Workforce Competency Dictionary

CompID	Designator	Title
85	IASYS	Intelligent/Adaptive Systems
86	MMA	Mathematical Modeling & Analysis
87	DATAVIS	Data Visualization
88	GST	Geospatial Science and Technologies
89	ADVMIS	Advanced Mission Analysis
90	ASCDTA	Aerospace Systems Concept Development & Technology
91	AADMD	Advanced Analysis and Design Method Development
92	LASER	Laser Technology
93	OPTSYS	Optical Systems
94	MICROSYS	Microwave Systems
95	RST	Remote Sensing Technologies
96	DETECTSYS	Detector Systems
97	CSAOPS	Crew Systems and Aviation Operations
98	FLTDYN	Flight Dynamics
99	APPLAERO	Applied Aerodynamics
100	AEROELA	Aeroelasticity
101	AERODYN	Aerodynamics
102	AEROTHM	Aerothermodynamics
103	ACOUSTICS	Acoustics
104	THMSYS	Thermal Systems
105	THMSTR	Thermal Structures
106	FLDSYS	Fluid Systems
107	ICEPHY	Icing Physics
108	ATS	Air Traffic Systems
109	AETT	Advanced Experimentation and Testing Technologies
110	SIMFLTSYS	Simulation/Flight Research Systems
111	ADVMDI	Advanced Measurement, Diagnostics, and Instrumentation
112	ARCHENG	Architectural Engineering
113	BUSMMT	Business Management
114	PROCENG	Process Engineering
115	ADMSUP	Administrative Support
116	BUSDEV	Partnership & Business Development
117	COMTEC	Commercial Technology
118	FINMMT	Financial Management
119	BUDGETMMT	Budgeting Management
120	INTAUD	Internal Control / Audit
121	COSTEST	Cost Estimation Analysis
122	PROJPROGMT	Program/Project Management
123	RISKMMT	Risk Management
124	CONMMT	Acquisition and Contract Management
125	LEGAL	Legal
126	PSEC	Physical Security
127	INSCOMP	Inspection, Investigation and Compliance
128	HUMRES	Human Resources

Workforce Competency Dictionary

CompID	Designator	Title
129	EEO	EEO
130	OCCENV	Occupational and Environmental Health & Safety
131	BUSITSYS	Business IT Systems
132	RESFACPLAN	Research Facilities Planning
133	ENVENGMMT	Institutional Environmental Engineering & Management
134	LOGSUPTRAN	Institutional Logistics, Supply and Transportation
135	PUBLICOMM	Public Communications & Outreach
136	GOVAF	Governmental Affairs
137	EDTECH	Education Programs and Technologies
138	NUCLEARENG	Nuclear Engineering
139	SWASSURANCE	Software Assurance Engineering
140	LEADERSHIP	Leadership
141	PERSCOMM	Personal Communication
142	RELATIONSHIP	Relationship Management
143	FIREPROT	Fire Protection Engineering
144	EXPORT	Export Control
145	INSFACPLAN	Institutional Facilities Planning
146	INSFACOPS	Institutional Facilities Operations
147	PROJANALYSIS	Program/Project Analysis
148	RESFACOPS	Research Facilities Operations

Appendix B: Proficiency Guideline Table

- The following table provides a generic set of guidelines. It identifies some basic knowledge measurements that are common across all competencies and professional disciplines.
- To identify an employee's level of proficiency for a specific competency, the employee should be able to demonstrate all the items listed under a single tier column.
- An individual may have greater expertise (which would show under a high tier column) in one or more of the knowledge measurements below. However, for the purposes of this exercise and the current business rules, the employee must accomplish all of the items in the tier column to be considered at that level of proficiency.
- This table is a tool that should be used by the employee and supervisor. However, the set of measurements do not represent an exhaustive list, and the criterion is not perfect. Therefore, an employee or supervisor's assessment may include additional factors that are not represented below. The intent for collecting the data is to identify an individual's depth of knowledge for a given competency that can be compared with others through out the Agency with the same competency, such that a subject matter expert at one Center is on equal knowledge par with a subject matter expert at another Center.
- These guidelines, and the corresponding business rules, may change as the data is analyzed and the overall system matures. For suggestions on improvements to the criteria, please contact the CMS Operation Manager at your Center.

Knowledge Measurement	Tier 1	Tier 2	Tier 3	Tier 4
Tools	Demonstrates basic knowledge of and proficiency in the use of discipline-related tools and their outputs.	Demonstrates working knowledge of and high proficiency in the use of discipline-related tools and related outputs.	Demonstrates ability to effectively assess new discipline-related tools and their application to the organization's work.	Demonstrates the ability to develop standards and specifications for new discipline-related tools and their application.
Data Collection and Analysis	Demonstrates ability to compile and analyze data.	Demonstrates ability to summarize data and produce technical outputs.	Demonstrates ability to effectively execute data analysis to determine performance of organization or discipline-related systems, processes and events.	
Sharing Knowledge	Demonstrates willingness to contribute organization or discipline-related knowledge and information to the related community.	Routinely contributes organization or discipline-related knowledge and information to the related community.	Demonstrates comprehensive knowledge of and contributes to resources available in the related community including NASA, DOD, universities, and industry. Demonstrates willingness to and performs as a mentor or coach to other personnel.	Demonstrates ability to serve as an Agency and industry-wide resource and has built a network to facilitate the acquisition of other resources and information.
Safety	Demonstrates awareness of safety procedures and related best practices for applicable work.	Demonstrates knowledge of and applies safety procedures and related best practices to related work.	Demonstrates comprehensive knowledge of and incorporates safety procedures and requirements to related work and organization.	Demonstrates ability to develop and/or modify safety procedures and requirements for related work and organization.
CENTER, NASA and Industry	Maintains awareness of applicable CENTER,	Maintains working knowledge of applicable	Maintains comprehensive	

Trends Standards and Resources	NASA, aerospace and/or industry standards and policies.	CENTER, NASA, aerospace and/or industry trends, standards and policies.	knowledge of applicable CENTER, NASA, aerospace and/or industry trends, standards and policies.	
Problem Solving	Demonstrates ability to identify work-related problems.	Demonstrates ability to solve simple work-related problems.	Demonstrates ability to develop or change procedures/processes to resolve and/or prevent difficult technical issues.	Routinely provides design concepts, risk management, trouble-shooting and trade-off analysis.

- The table below provides some additional guidelines that can be used for selected competencies, which may be more applicable to certain positions than others (such as engineering, quality safety and assurance, etc.) . It is left to the discretion of the employee and supervisor to determine which items may apply to their work situation.

Knowledge Measurement	Tier 1	Tier 2	Tier 3	Tier 4
Safety	Demonstrates awareness of safety procedures and related best practices for applicable work.	Demonstrates knowledge of and applies safety procedures and related best practices to related work.	Demonstrates comprehensive knowledge of and incorporates safety procedures and requirements to related work and organization.	Demonstrates ability to develop and/or modify safety procedures and requirements for related work and organization.
General Knowledge and Capabilities	Demonstrates ability to follow prescribed procedures and implement plans. Can effectively write procedures for simple systems. Demonstrates ability to effectively write basic requirements for simple design, test, operational and maintenance procedures. Demonstrates knowledge of basic design, test, operations and maintenance standards and requirements. Demonstrates ability to coordinate requirements definition for small projects. Attends preliminary and critical design reviews.	Maintains the ability to specify critical requirements for experiments and characteristics for related systems. Demonstrates ability to coordinate and test within a single discipline. Demonstrates depth of knowledge for one or more specific area(s) of specialization or sub-systems. Has participated in discussions of technical issues related to designs during design reviews. Demonstrates proficiency in reviewing and providing insight into requirements, standards and related documents for research, design or process forums such as SBIR, design reviews, etc. Demonstrates the ability to integrate customer requirements with situational constraints and interfaces.	Demonstrates ability to design experiments or tests. Develops an area of scientific or engineering expertise. Demonstrates capability to effectively contribute technical inputs to complex forums such as design reviews, SEBs, program reviews and proposals. Has effectively performed as the primary technical interface for customers external to the Center. Demonstrates skill in overcoming material and system issues in complex systems. Demonstrates thorough knowledge of at least one complete system, including related instrumentation, controls, data acquisition and mechanisms. Demonstrates ability to perform verification planning and oversight	Demonstrates technical expertise to represent the Center on Agency-wide, industry and academic working groups, boards and panels.

		Has effectively performed as an engineer or designer on a multi-disciplinary project team. Has successfully participated on a cross-organizational design, development, or manufacturing team. Demonstrates ability to identify deficiencies in operational processes and tools and propose cost-effective solutions. Demonstrates the ability to perform verification planning and oversight of integration and test at the sub-system level.	of integration and test at the system-level. Demonstrates ability to integrate systems, including related system requirements and interfaces. Demonstrates the ability to review and assess complex technical documents for their impact on work.	

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